Corruption and Sustainable Development

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Abstract

This paper studies the relationship between corruption and sustainable development in a sample of 110 countries between 1996 and 2007. Sustainability is measured by growth in genuine wealth per capita. The empirical analysis consistently finds that cross-national measures of perceived and experienced corruption reduce growth in genuine wealth per capita. In contrast to the evidence on the relationship between corruption and growth in GDP per capita, the negative correlation between a wide range of different corruption indices and growth in genuine wealth per capita is very robust and is of economic as well as of statistical significance. We relate the finding to the literature on the resource curse and demonstrate that rampant corruption can put an economy on an unsustainable path along which its capital base is being eroded.

Keywords: Corruption, sustainable development, resource curse, cross-country analysis
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1. Introduction

Corruption in its various forms is generally believed to be an obstacle to economic development.[3] Anti-corruption reforms and policies consequently offer great promise to

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contribute to the wellbeing of millions of people. The seminal paper by Mauro (1995), which spurred a large empirical literature[4], concluded that “if Bangladesh were to improve the integrity and efficiency of its bureaucracy to the level of that of Uruguay.... its yearly GDP growth rate would rise by over half a percentage point” (p. 683). Yet, in subsequent work on macroeconomic data, it has proved hard to find robust evidence that corruption, as opposed to general government inefficiency, has a sizable negative effect on growth in real GDP per capita (see, e.g., Aidt, 2009). On the other hand, the evidence of a strong negative correlation between the level of GDP per capita and corruption is overwhelming, but *a priori* the direction of causality is unclear. Murphy et al. (1993), Ehrlich and Lui (1999), Lambsdorff (2007) and many others see the causality as running from high corruption to low income, while Treisman (2000) and Paldam (2002), amongst others, argue that a transition from a situation with high corruption to one with low corruption is a bi-product of economic development. In a recent paper, Gundlach and Paldam (2009a) use deep prehistoric measures of biogeography as instruments for GDP per capita to demonstrate that the long-run causality runs from low levels of development to high corruption, thus suggesting that the reverse link between a high level of corruption and low national income is, at most, part of the short-run dynamics of development.

While the insights from the research program on the GDP-corruption nexus are valuable and important for one’s understanding of the macroeconomics of corruption, there is a sense in which that research programme is barking up the wrong tree. Policy advice should ideally be guided by considerations of social welfare. GDP per capita is a poor indicator of that concept. It measures current economic activity, but ignores many key determinants of human well-being (e.g., social relations, health, and personal safety), the possible destruction of natural capital in the quest for higher incomes, the value of home production, etc. In other words, research should be directed at questions related to *sustainable* development rather than *economic* development, narrowly defined. Sustainable development relates to an economy's ability to maintain living standards through time; growth in GDP per capita is no guarantee for long-run sustainability.

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[3] There is a dissenting view which contends that corruption can, in some restricted sense, be efficiency-enhancing by allowing economic agents to overcome pre-existing, inefficient regulation and red tape (e.g., Leff, 1964; Levy, 2007). Macro-level evidence pointing in this direction is provided by e.g., Méon and Weill (2010), Méndez and Sepúlveda (2006) and Egger and Winner (2005). Critical discussions of this view are presented in e.g., Aidt (2009), and the surveys by Bardhan (1997) or Aidt (2003).

[4] E.g. Mo (2001) and the survey by Svensson (2005)

In recent years, progress has been made in constructing empirical measures of social welfare and sustainable development. Fleurbaey (2009), in a recent survey in the Journal of Economic Literature, highlights three main approaches to the measurement of social welfare: adjusted GDP, happiness indices, and the Human Development Index based on Sen's capability approach.[5] Each of these approaches has advantages and disadvantages. The happiness approach, which is based on survey evidence aimed at eliciting information concerning subjective well-being, suffers from serious problems of comparability across time and space.[6] The Human Development Index, which is an index of social welfare constructed from averages of GDP per capita and indicators of health and education outcomes, faces the so-called "index problem": if a single index is defined that weights different aspects of life in the same way for all individuals, then these common weights do not respect the individuals' own valuations of these aspects. The adjusted GDP approach is based firmly on welfare economics and aims to derive indicators of the change in social welfare, rather than measures of the level of welfare as such. The most sophisticated indicators focus explicitly on the inter-temporal dimension of social welfare and can, in contrast, to the other measures, address issues related to sustainable development directly (Dasgupta, 2001, chapter 9; Dasgupta, 2010). The basic insight provided is that an economy's capital stocks, broadly defined to include manufactured, human, social and natural capital, and the way in which these are managed, matter for the inter-temporal well-being of individuals. Moreover, changes in inter-temporal social welfare can be measured by variations in these stocks at current accounting prices or by variations in what is called "genuine investment". Although this approach also suffers from conceptual weaknesses (e.g., it is based on the theory of revealed preference) and practical implementation problems (e.g., the capability of one measurement to compare accounting prices across economies), these issues seem less of an obstacle for empirical research than those associated with the alternatives. For this reason, we argue that genuine investment, and the associated growth in genuine wealth per capita, is the best available indicator of sustainable development. We shall use such measures to revisit the macroeconomics of the corruption-development nexus, but with an emphasis on sustainable development, rather than on more narrowly-defined economic development.

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[5] He also considers a fourth approach, which is a synthesis of the others.
[6] The approach has, nonetheless, been used to illuminate many important links between economic fundamentals, institutions, and human wellbeing (see, e.g., Frey and Stutzer, 2002).

Development is, however, not the only concept that it is hard to quantify empirically. It is equally difficult to construct reliable and accurate measures of corruption (Jain (2001) provides a good discussion). Most macroeconomic research explores cross-national differences in corruption perceptions. It is well-known that such perceptions may be biased and directly related to prevailing economic and social conditions and, in that way, create a spurious correlation between corruption and economic development. This suspicion is recently confirmed by Treisman (2007) and Aidt (2009). Treisman (2007) compares the determinants of corruption perceptions to the determinants of indicators of individuals' self-reported experiences with bribe giving ("experienced corruption"). He finds that many of the traditional determinants of corruption perceptions do not correlate well with indices of experienced corruption. Aidt (2009) re-examines the relationship between growth in GDP per capita and corruption and finds that the correlation between indices of experienced corruption and growth in GDP per capita is practically zero. This strongly suggests that the neither the causes nor the consequences of perceived and experienced corruption are the same. However, survey-based indices of experienced corruption also suffer from many weaknesses (e.g. related to selective non-response), and so neither of the two types of measures are perfect. We take the view here that the way forward is to study both types of indicators and, in that way, gauge the robustness of any relationship between corruption (measured by a variety of means) and sustainable development.

The contribution of this Chapter is to revisit the classical macroeconomic question of the impact of corruption on development, but from a new angle. First, we inquire into the effect of corruption on sustainable development, as opposed to more narrowly-defined economic development. Second, we study the role of corruption perceptions as well as the role of individuals' self-reported experience with corruption. We find that corruption, by whatever means it is measured, is detrimental to sustainable development in a sample of up to 110 countries covering the period 1996 to 2007. This correlation is robust across many different specifications in contrast with the literature on GDP growth and corruption. Although, the World Bank has published estimates of genuine investment for a number of years, only a small number of studies[7] have used them to study potential links between economic, social, and political factors and sustainable development.

The Chapter is organized as follows. Section 2 discusses sustainable development in more detail and its links with corruption. Section 3 discusses the measurement problems associated with quantifying corruption. Section 4 takes a first look at the data and demonstrates a suggestive (negative) correlation between corruption and sustainable development. Section 5 sets out the estimation strategy while Section 6 presents the main results. We report results from a pooled ordinary least squares (OLS) estimator, from a Hausman-Taylor random effects estimator, and from an instrumental variables approach. Section 7 summarizes the robustness checks implemented in the study, and Section 8 concludes the Chapter with ideas for further research and thoughts on policy implications.

2. Sustainable development

Most of the empirical research on the consequences of corruption at the economy-wide level uses real GDP per capita to measure development. Ultimately, development is concerned with sustainable improvements in human welfare. It is widely recognized that GDP per capita is not necessarily a good measure of such improvements. In a nutshell, the problem is that GDP per capita is a flow variable. It records, at market prices, the value of the goods and services produced by an economy in a given year. This flow can, however, be increased over a period of time by running down an economy's capital stocks – for example, its reserves of renewable and non-renewable resources, or its stock of human capital – but with the consequence that these stocks of capital are then partly lost for the future. It is, therefore, quite possible that an observed increase in the growth rate of GDP per capita over a period of time may correspond to a fall in inter-temporal social welfare when the consequences for future generations are considered. This implies that we must look to other measures to assess the effects of corruption on sustainable development.

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[7]See Atkinson and Hamilton (2003) and Neumayer (2004).

2.1. Framework and concepts

Sustainable development is loosely defined as present economic paths that do not compromise the well-being of future generations (World Commission, 1997). Arrow et al. (2004) propose a more precise definition which we adopt for the purpose of our study. Their starting point is an index of the inter-temporal social welfare of an economy at a given time *t*. Inter-temporal social welfare, denoted by V_t, is a measure of the present discounted value of social welfare attained at each future date along a given development path. An economy is, then, said to be on a sustainable development path if and only if V_t is not decreasing over time along that path. Clearly, this definition puts the emphasis on the change in social welfare, not on its level, and on the inter-temporal aspect. One consequence of the inter-temporal emphasis is that trade-offs are allowed, in the sense that social welfare may be lower at some future date than it is today so long as the discounted present value is not declining.[8]

It is useful to develop a simple theoretical framework to examine more clearly how corruption may influence the prospect of sustainable development. The framework builds on Dasgupta and Mäler (2000). They imagine a society populated by many identical individuals who live forever. Time (t) is continuous. For simplicity, we assume that the population size is fixed. The economy produces an all-purpose good (Y_t) from labor (L_t), manufactured capital (K_t), and the flow of natural resources (R_t). The production technology is represented as:

$$Y_t = F(L_t, K_t, R_t), \tag{1}$$

where F increases in each of the three arguments and is continuously differentiable. It is important to stress that the production function need not be concave. As a consequence, our results regarding sustainable development and corruption apply to a wide class of economies with externalities and other market and government failures. Manufactured capital evolves over time according to the following law of motion:

$$\frac{dK_t}{dt} = F(L_t, K_t, R_t) - C_t \equiv I_t^K, \tag{2}$$

[8] See Arrow et al. (2004, p. 150) for further discussion of the implications of this definition.

where C_t is aggregate consumption, I_t^K is investment in manufactured capital, and it is assumed that there is no depreciation. The natural resource base (S_t) evolves according to the following law of motion:

$$\text{(3)} \qquad \frac{dS_t}{dt} = M(S_t) - R_t \equiv I_t^S,$$

where $M(S_t)$ is the natural rate of regeneration of the resource and I_t^S can be interpreted as the net investment in the resource base. For non-renewable resources, the regeneration rate is zero for all S_t, while for renewable resources it is positive. Individuals derive utility from consumption and disutility from labor supply. This is represented by a concave utility function, $U(C_t, L_t)$. Inter-temporal social welfare at time t can, then, be defined by a utilitarian social welfare function:

$$\text{(4)} \qquad V_t = \int_t^{\infty} U(C_\tau, L_\tau)\, e^{\delta(\tau-t)} d\tau$$

where δ>0 is the (utility) discount factor. A development path P_τ starting at time τ is a projection into the future of all relevant economic quantities, i.e., $P_\tau \equiv \{C_\tau, L_\tau, R_\tau, K_\tau, S_\tau\}_{\tau=t}^{\infty}$. The economy's institutions govern which of the infinitely many potential development paths is actually chosen. These include economic institutions, such as markets and trade regimes, legal institutions that govern the way disputes are settled, and political institutions that determine how the economy is governed, by whom, and regulate how power is contested, etc. Particular institutions select particular development paths through the choices made by private individuals and public sector officials under those prevailing institutions. There is no presumption that institutions are perfect. Economic institutions can be dysfunctional (distorted markets, unregulated monopolies, etc.) or not, rent-seeking may be kept in check or not, the society may be governed by a democratically elected leader or by a dictator, and corruption may or may not be controlled through monitoring or wage incentives. What is important for the arguments that follow is that the institutions can be taken as given; they can be affected by reform, but do not evolve organically over time.[9] Society's institutions are formally defined as a function, α, that, given the state of the economy at each time *t*, $\{K_t, S_t\}$, selects a development path ($\hat{P}_t$) from the

[9] This is a strong assumption but one which can be justified by the so-called "critical junctions" theory of institutional development. According to this theory, institutional reform happens at critical junctions in history. Once the new institutions are in place, they persist for a long time - until the next critical junction. See Acemoglu et al. (2001) for an example of this with regard to political institutions and La Porta et al. (1997) with regard to legal institutions. This view is, however, challenged by modernization theory, according to which democratic institutions gradually emerge as a consequence of economic development (see, e.g., Gundlach and Paldam, 2009b, and Guerriero (2010) who shows legal institutions also evolve gradually in response to socio-economic factors).

set of all feasible paths. We can then write inter-temporal social welfare explicitly as a function of institutions and their stocks of capital: $V_t = V(\alpha, K_t, S_t)$.

The key question is how, in practice, we can judge whether the development path chosen by a society ($\hat{P}_t$) is sustainable or not. By definition, sustainability requires that inter-temporal social welfare is not declining over time. Since inter-temporal social welfare is not something that can be readily observed, this is, in itself, not very helpful for evaluating development paths empirically. Fortunately, Dasgupta and Mäler (2000) prove two important equivalence results which provide the fuzzy concept of sustainability with real empirical content.[10] We shall focus on the most immediate of these as that suffices for our present purpose. The social scarcity of two capital assets can be measured by their accounting or shadow prices:

(5) $$p_t(\alpha) \equiv \frac{\partial V(\alpha, K_t, S_t)}{\partial K_t},$$

(6) $$q_t(\alpha) \equiv \frac{\partial V(\alpha, K_t, S_t)}{\partial S_t}.$$

The shadow prices measure the change is inter-temporal social welfare associated with a small increase in the relevant capital stock. Recall that inter-temporal social welfare is a function of institutions and capital stocks, i.e., $V_t = V(\alpha, K_t, S_t)$. Calculation of the total derivative, keeping institutions fixed, gives:

(7) $$\frac{dV_t}{dt} = \frac{\partial V}{\partial K_t}\frac{dK_t}{dt} + \frac{\partial V}{\partial S_t}\frac{dS_t}{dt}.$$

Using the definitions of the accounting prices from above (equations (5) and (6)), along with equations (2) and (3), we can rewrite equation (7) as:

(8) $$\frac{dV_t}{dt} = p_t(\alpha)I_t^K + q_t(\alpha)I_t^S \equiv GI,$$

where GI is short-hand for genuine investment.[11] Genuine investment reflects the change in society's genuine wealth (GW), i.e., $GI_t \equiv \frac{dGW_t}{dt}$. Genuine investment is linked to the change in inter-temporal social welfare through equation (8), which provides the fundamental link between theory and empirical implementation. This says that the change in inter-temporal social welfare at time *t* in a society governed by institutions α is increasing if, and only if, the net investment in its genuine wealth is positive, i.e., if, and only if, genuine investment is positive. In other words,

[10] See also Dasgupta (2001, chapter 9) and Hamilton and Clemens (1999).
[11] The term genuine saving is sometimes used in this context. Empirically, we cannot distinguish the two. In this study we follow Arrow et al. (2004) and refer to the change in an economy's genuine wealth as genuine investment.

the main determinant of inter-temporal social welfare is an economy's productive base. This base consists of all the economy's capital assets, including manufactured and natural capital, as in the model, but, more generally, it also includes human and social capital. The change in the productive base can be expressed as the sum of the values of investment or disinvestment in the underlying capital assets, where the assets are priced at their social opportunity cost, i.e., at shadow prices. From an empirical point of view, there is some hope that genuine investment (GI) can be estimated, while inter-temporal social welfare itself is much harder, if not impossible, to measure objectively. We return to this below, but first we inquire into the effect of corruption on sustainability, as defined by the index of genuine investment.

Corruption has the potential to undermine sustainable development in many ways. The extent to which corruption actually does so is determined by an economy's institutions and its existing capital assets. This is because they control the opportunities and incentives for politicians and bureaucrats to engage in the 'sale of public assets for private gain' (Shleifer and Vishny, 1993). Returning to equation (8), sustainable development requires suitable investment in the economy's capital assets. A vast empirical literature strongly suggests that corruption is one reason why many societies do not make sufficient investments in their productive base. Take, for example, education, i.e., investment in the stock of human capital. Since education is associated with positive externalities, the social value of these investments exceeds the private return and public funding is justified from a social point of view, in particular for primary education. But do the funds committed always reach the schools? Expenditure tracking surveys undertaken by the World Bank in Africa suggest that the answer is no: corrupt officials manage to diverge the flow of funds to other purposes, most likely to private consumption, somewhere along the way from the Treasury to the schools. The most extreme example of this is from Uganda in the mid-1990s, where about 80 percent of the funds intended for the surveyed schools disappeared (Reinikka and Svensson, 2004). On top of that, the macroeconomic evidence presented by Mauro (1998), Tanzi (1998) and many others shows how corruption distorts the portfolio of public spending by shifting resources away education and towards public consumption. In short, there are good reasons to believe that corruption undermines the accumulation of human capital and may thus be a cause of unsustainable development.

Another example is investment in manufactured capital. A large theoretical literature highlights different reasons why corruption reduces the incentive to invest.[12] The basic point is that corruption, through the sale of investment licenses or simply through creation of red tape and rent-seeking, serves as a tax on investment. The macroeconomic evidence strongly confirms that investment does not thrive in a corrupt environment. In fact, the most robust result of Mauro's (1995) seminal study is that perceived corruption and bureaucratic inefficiency are negatively related to investment in manufactured capital. This finding has been confirmed and elaborated on by many others since then.[13] Tanzi and Davoodi (1998), for example, show that corruption tends to increase public investment, but that it is associated with low operation and maintenance expenditures and with poor quality of infrastructure, i.e., with investments of lower quality. Moreover, Wei (2000) demonstrates that corruption acts like a tax on international investments. He reports that an increase in the (perceived) corruption level from that of Singapore to that of Mexico would have the same negative effect on inward foreign direct investment as raising the tax rate on foreign investment by fifty percentage points.[14] Along similar lines, Rose-Ackerman (1999, chapter 3) argues that corrupt politicians favor investment projects with inefficiently high capital-intensity ("white elephants") because the stream of bribe income generated by such projects is front-loaded. As a consequence of this bias, too little investment is subsequently made in maintaining the capital. This effect is magnified by political instability which, in itself, reduces the time horizon of politicians.

The final example relates to the management of natural capital. Leite and Weidmann (2002) and many others provide macroeconomic evidence on the close association between extraction of natural resources, resource rents, and corruption. Anecdotal evidence linking the exploitation of natural resources to corruption is also abundant, ranging from kick-backs associated with logging concessions in Malaysia and Indonesia to oil concessions in Nigeria. (Rose-Ackerman (1999, chapter 3) provides many more examples). The consequence of these distortions is

[12] See, e.g., Krusell and Rios-Rull (1996), Murphy et al. (1991, 1993), Blackburn et al., (2006, 2008), or Ellis and Fender (2006).

[13] Most of this evidence relates to perceived corruption. A notable exception is Campos et al. (1999). They use data on self-reported experience with bribe giving from the World Bank's Business Enterprise Survey and demonstrate that experienced corruption, both the level and its predictability, is negatively related to investment in manufactured capital.

[14] Others have, however, found that corruption attracts foreign direct investment (Egger and Winner, 2005; Sena and Martianova, 2008).

environmental degradation. In fact, this is directly related to a vast literature on the so-called resource curse. Economic logic suggests that abundance of natural resources should be beneficial for economic development. After all, extraction of natural resources has a direct positive effect on GDP and the resource rent can, in principle, be taxed away without distorting economic decisions and invested in various capital assets, allowing a resource-abundant economy to enjoy higher levels of consumption than a resource-scarce economy, not just in the short run but also in the long term. Yet, as first demonstrated by Sachs and Warner (1995), despite this apparent advantage, resource-rich countries tend to grow at a slower rate than other countries.[15] One often-cited reason for this curse is that resource abundance fosters a 'rentier' economy with rampant corruption and poorly developed institutions (e.g., Auty, 1993; Lane and Tornell, 1996; Robinson et al. 2006; Mehlum et al. 2006; Hodler, 2006). Such an environment not only encourages over use of the natural resource base, also crowds out investment in manufactured and human capital (Gylfason, 2001; Papyrakis and Gerlagh, 2006), misallocates talent away from innovative activities to rent-seeking (Acemoglu and Verdier, 1998) and encourages growth-harming increases in government consumption (Atkinson and Hamilton, 2003). While natural resources used in this way can feed corruption, the adverse effect can, as demonstrated by Bhattacharyya and Hodler (2010), be mitigated by high quality democratic institutions. Yet, the general message from this literature is that resource rents induce corruption where institutions are weak, and that corruption and weak institutions encourage over use of natural capital. The implied net result is a significant fall in genuine investment.

These examples show that corruption can be a threat to sustainable development through the effect it has on investment in an economy's productive base. However, they also demonstrate another basic point. The effect of corruption on economic growth, defined in terms of GDP per capita, is likely to be smaller than the corresponding effect of corruption on genuine investment and sustainability, at least over the medium term. To demonstrate this, equation (1) is used to calculate the rate of change of GDP (keeping labor input fixed for simplicity):

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[15]The most recent evidence on the resource curse (Brunnschweiler and Bulte, 2008; Ploeg and Poelhekke, 2010), which corrects for various endogeneity problems, however, casts some doubt on the simple proposition that resource abundance reduces economic growth unconditionally. For example, Ploeg and Poelhekke (2009) show that the effect works through economic instability and that only where economic instability is sufficiently large is resource abundance a curse.

(9) $$\frac{dY_t}{dt} = \frac{\partial F}{\partial K_t} I_t^K(\alpha) + \frac{\partial F}{\partial R_t}\frac{\partial R_t}{\partial t}(\alpha)$$

and the result is compared to that from equation (8), reproduced here for convenience:

(8') $$\frac{dV_t}{dt} = p_t(\alpha) I_t^K + q_t(\alpha) I_t^S \equiv GI$$

If we suppose that corruption has a negative effect on investment in manufactured capital (for one of the reasons discussed above), this would show up both as a reduction in the rate of change of GDP *and* as a reduction in genuine investment. However, if we suppose, instead, that corrupt politicians plunder a society's natural resources by selling off mineral, fishing or oil rights for private gain, or by allowing developers, in exchange for a bribe, to build on land that should, from a social point of view, have been protected because of the eco-services it provides, and that the proceeds from these transactions are directed at immediate consumption rather than at investment in other capital stocks,[16] corruption then induces an immediate increase in the rate of change of GDP ($\frac{\partial R_t}{\partial t}$ in equation (9) increases) while genuine investment falls (I_t^S in equation (8) falls). This observation goes some way towards explaining why it is hard to find the effect of corruption on the growth rate of GDP: conflicting effects may mitigate each other. On the other hand, the impact on genuine investment is unambiguously negative. Again, this line of reasoning has a parallel in literature on the resource curse. Atkinson and Hamilton (2003) argue that negative genuine investment tends to be associated with resource abundance. Along similar lines, Neumayer (2004), using cross-national data on GDP adjusted for depreciation of natural capital, demonstrates that the impact of resource abundance on adjusted GDP growth is smaller than the impact on unadjusted GDP growth. This is consistent with the notion that the effects of mismanagement of natural resources fall more directly on genuine investment than on the growth rate of GDP.

2.2. How should genuine investment be measured?

In order to study whether corruption is actually associated with, or perhaps even a cause of, unsustainable development, as suggested by the analysis above, empirical estimates of genuine investment across time and space are needed. Although it is conceptually clear from equation (8)

[16] Rodriguez and Sachs (1999) provide a similar argument with an application to the oil boom in Venezuela.

what needs to be measured, it is not a straightforward task to do this. One problem is to estimate the accounting prices. Another is how to take population and total factor productivity growth (factors which were ignored above, but obviously matter in practice) into account. A third problem is how to define the relevant capital stocks and then to measure the investment or disinvestment in them. A fourth problem is to do all this in a way that makes international comparisons possible.

Fortunately, progress has been made in constructing rough empirical proxies for genuine investment. The World Bank, as part of the World Development Indicators, publishes an estimate of genuine investment on a yearly basis for a large number of countries, based on the work by Hamilton and Clemens (1999), Hamilton (2005) and others.[17] Table 1 presents the figures for genuine investment from a selection of six countries and illustrates how they are calculated.

[Table 1: Genuine Investment in Selected Countries, average figures for 1996-2007]

Genuine investment is estimated from gross national savings by making four adjustments that reflect investment or disinvestment in the economy's productive base.[18] The first adjustment is to deduct an estimate of consumption of fixed capital to account for depreciation of manufactured capital. This represents the replacement value of capital consumed by the process of production. The second adjustment is to add an estimate of investment in human capital. Public expenditure on education is used as a proxy for this.[19] The third adjustment relates to the social cost of environmental pollution and has two parts. The first is designed to capture the cost of global warming. An estimate of the social cost of carbon dioxide emissions is subtracted from national savings, with the assumption that the average social cost of a tonne of carbon is US$30. The second part is designed to capture the impact of local environmental degradation. The World Bank makes a deduction for and makes a financial deduction for an estimate of the health

[17] See World Development Indicators (various years, Table 3.15). The World Development Indicators uses the term “adjusted net saving” or “genuine saving” to describe what we refer to as “genuine investment”.

[18] For details of how to estimate these deductions, see Bolt et al. (2002), or Arrow et al. (2004).

[19] This includes current operating expenditures on wages and salaries but excludes capital investment in buildings and equipment.

damages due to urban air pollution (particulate emissions) from gross savings. The fourth adjustment is also environmentally motivated. It is used to account for energy depletion, mineral depletion, and net forest depletion by subtracting an estimate of the relevant resource rents from net national savings. These rents are calculated as the market price of the resource minus average extraction cost for the two non-renewable resources (energy and mineral depletion). For renewable forest resources, the rent is estimated as the market price per unit of harvest in excess of the natural regeneration rate.

The result of these adjustments on gross national savings provides a rough estimate of genuine investment in terms of the percentage of gross national income (GNI). The figures are reported in column 9 of Table 1. We apply the method suggested by Arrow et al. (2003) to convert this into an estimate of growth in genuine wealth per capita. It starts by converting the estimate of average genuine investment on percentage of GNI into a growth rate of genuine wealth by multiplying by a presumed GNI-wealth ratio (υ).[20] Arrow et al. (2004) use a ratio of 0.2 for industrialized countries and a ratio of 0.15 for developing and oil-rich countries. Next, the population growth rate (n) is subtracted from this. In short, our empirical measure of sustainability is:

$$\frac{\frac{dgw}{dt}}{gw} = \frac{GI}{GNI}\upsilon - \mathrm{n}, \tag{10}$$

where gw represents genuine wealth per capita. The net result for the six countries is reported in column 10 of Table 1. Column 11 records the annual growth rates of GDP per capita for comparison. All six countries experience positive GDP growth during the period from 1970 to 2000. However, the estimates of growth in genuine wealth per capita suggest a bleaker picture: the current development paths of Brazil, Kenya and Nigeria are unsustainable in the sense that they, on average, experienced negative growth in genuine wealth per capita over the period.

How reliable are these data? Clearly, they must be considered very rough indicators of sustainability as defined by equation (8). For example, market prices are used to value investment in human capital, but we know that this does not reflect the social value of such investment. The calculations of the resource rent associated with the various non-renewable and

[20] See Hamilton (2005) for an alternative way of making this adjustment. Aidt (2009) shows that it makes little difference which of the two methods are used for the statistical analysis of the link between corruption and sustainable development. In the interest of brevity, we focus on the one advocated by Arrow et al. (2004).

renewable resources are based on average costs, not on marginal costs as they should be. Moreover, they use uniform world market prices thereby ignoring between-country quality differences in, say, minerals or wood. In addition, clearly not all capital assets have been counted. Most importantly, estimates of depletion of fish stocks, erosion of topsoil or depletion of water reserves are not included. Total factor productivity is also ignored.[21] The calculations are also sensitive to the choice of wealth to GNI ratios. The social cost of carbon emissions seems on the low side and, in any case, represents an average value rather than social marginal cost. It is clear, therefore, that there is ample room for improvement and that these data are noisy. However, the trade-off between getting the details right for a few cases and getting a rough proxy for many cases is important. The trade-off comes down in favor of the later for answering many interesting research questions, including the ones at hand here. In conclusion, for the purpose of our statistical analysis, we take these data at face value as the best available proxy for sustainable development. In Section 8, we discuss some concrete improvements that could be introduced in future research.

3. Corruption

Corruption is also an elusive object to quantify and a perfect index or ranking does not exist for the purpose of cross-national comparisons. The approach followed here is to emphasize robustness and make use of six different cross-national corruption indicators.[22] These indicators fall into two groups. The first group contains cross-country indices of corruption perceptions. These are based on surveys of business consultants, local and international businessmen, or of ordinary citizens. The two most commonly used indices of this type are the Corruption Perception Index, published by Transparency International (the *TI index*),[23] and the Control of Corruption Index, published by the World Bank (the *WB index*).[24,25] The original TI-index

[21] Conceptually, one could adjust for this if information on country-specific estimates of total factor productivity growth were available (Arrow et al., 2004). Without such data, however, we decided not to make any adjustments, rather than applying a one-size-fits-all adjustment based on a guesstimate.
[22] At the national level several "objective" measures of corruption are available. These include data on the number of officials convicted for corruption (see e.g., Alt and Lassen (2003) in a study of US states, and Del Monte and Papagni (2001) in a study of Itaian regions) and data concerning the amount of leakage from infrastructure projects in Italian regions (Golden and Picci, 2005).
[23] http://www.transparency.org/
[24] http://info.worldbank.org/governance/wgi/index.asp

measures corruption on a scale from 0 to 10. We have re-scaled the index such that 10 represents maximum perceived corruption. Likewise, we have normalized the *WB index* to be between 0 and 1, with 1 representing the country with the least control of corruption. We also make use of the country ranking published yearly in the International Country Risk Guide.[26] This rating, which we refer to as the *ICRG index*, is based on evaluations made by a panel of experts, rather than on the aggregation of survey data from many different sources. The original ICRG index record these evaluations on a scale from 1 to 5. We have inverted the index so that 1 corresponds to low corruption and a value of 5 corresponds to high corruption. Data for the three indices are available from at least the 1990s. It is, however, debatable as to whether the variations in the data over time are informative or not. The problem with respect to the *TI* and the *WB index* is that the underlying data sources are not the same from year to year, and this can account for as much as half the over-time variation (Kaufmann and Kraay, 2002, pp. 13-14). The *ICRG index* avoids this problem since it is based on *one* yearly survey of a panel of experts, but has its own problems. As pointed out by Lambsdorff (2005), the index is actually designed to measure the risk of political instability caused by corruption rather than corruption itself, and this seems to generate unexpected movements over time in the index for some countries. Nevertheless, we shall, with this caveat in mind, attempt to use the changes over time in the *ICRG index* in our estimations.

The *TI*, the *WB* and the *ICRG index* all measure perceptions concerning the level of corruption in different countries. This is problematic insofar as there is a gap between perceptions and facts on the ground. Treisman (2007) provides an illuminating discussion of this point. Equally troublesome for the purpose of estimating the impact of corruption on sustainable development, these perceptions may be informed partly by the economic conditions prevailing in the country at the time the perception were formed. As an alternative to the three corruption perception indices, we can draw upon surveys of self-reported experiences with corruption. The World Bank's World Business Environment Survey (the WBES)[27] interviewed managers in 80 countries in 1999 and 2000, and asked them to respond to the following statement: “It is common for firms in

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[25] The two indices differ in the underlying source material used to construct the ratings; in the method used to aggregate the information, and in the time and country coverage, but are highly correlated.
[26] Unlike the other indexes, this index is not available for free.
[27] http://info.worldbank.org/governance/wbes/

my line of business to have to pay some irregular 'additional' payment to get things done". We have coded the *WBES index* based on the country averages, such that 1 corresponds to everyone answering "never" and 6 corresponds to everyone responding with "always". Transparency International conducted a similar survey – the Global Corruption Barometer (GCB) – in 2004 and 2005. This survey recorded the percentage of citizens in different countries who answered "Yes" to the question: "In the past 12 months, have you or anyone living in your household paid a bribe in any form?" We refer to this as the *GCB index*. Finally, the Inter-regional Crime and Justice Research Institute (UNICRI),[28] under the United Nations, conducted a survey in the late 1990s that recorded the percentage of respondents who had been asked to pay a bribe by government officials during previous year. We refer to this as the *UNICRI index*. The merit of these three indices is that they are each targeted at eliciting information from first-hand experience with corruption. Yet, like the perception-based indices, they have their weaknesses. First, selective non-despondence is likely to be a problem as respondents may have incentives to understate their experience with corruption. Second, it is also problematic that individuals are likely to adjust their behavior to past experiences with corruption. For example, they may stop engaging with certain public officials to avoid paying bribes. If so, when asked about bribe payments they might have made in the immediate past they truthfully report that they have made none, but only because they have stopped interacting with those officials who demand bribes. Both of these effects suggest that self-reported experience with corruption may under-estimate the true extent of bribery, and that the under-estimate may be systematically larger in countries with high levels of corruption. The fact that country coverage for respondents is much more sparse than for perceptions based indexes is also an issue for the present study.

Nonetheless, by making use of all six proxies for corruption, we hope to gauge the robustness of our statistical findings. Another good reason for focusing both on perception-based and experience-based indices of corruption is that they are likely to capture different aspects of corruption. The experience-based indices of corruption are clearly directed at measuring petty corruption. The perception-based indices may, in addition, pick up information concerning

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[28] http://www.unicri.it/

"grand corruption" and "government capture".[29] So, by studying both, we might be able to say something about the impact of different types of corruption on sustainability.

4. A first look at the data

Perhaps the most instructive way to eyeball the data is to split the sample of 110 countries into four groups. To do this, we, one the one hand, divide the countries into those with positive and negative, respectively, *growth in genuine wealth per capita* over the period from 1996 to 2007, and, on the other hand, we divide them into those with high and those with low corruption levels according to either the *WB* or the *WBES index*.[30]

[Table 2a: Cross-tabulation of *growth in genuine wealth per capita* and perceived corruption (the *WB index*)]
[Table 2b: Cross-tabulation of *growth in genuine wealth per capita* and actual corruption (the *WBES index*)]

The resulting two-way tabulations are shown in Tables 2a and 2b. The tables report the names of the countries that fall into each of the four cells. Table 2a shows the cross tabulation for the *WB index* and Table 2b shows the tabulation for the *WBES index*. The majority of countries fall on the left-right diagonal, i.e., either follow a sustainable path with low corruption or an unsustainable path with high corruption, but a sizeable minority manage to stay on a sustainable path, despite having high corruption. However, it is relatively rare that a country follows an unsustainable path while experiencing low corruption levels. All in all, these illustrations are suggestive of a negative correlation between sustainable development and corruption, but before we can draw firm conclusions, we need to subject the data to more thorough investigation.

[29] Rose-Ackerman (1999, chapters 3 and 5) discuses the distinction between petty and grand corruption in detail.
[30] We use the median level of corruption to classify countries as being high or low corruption.

5. Econometric specification

The theory, sketched in Section 2.1, suggests that *growth in genuine wealth per capita* is determined by three broad factors: the institutions that govern resource allocation (α), the productive base of the economy (the capital stocks), and the shadow prices of these resources along the chosen path. We will use this as a guide to formulate our econometric model. However, in doing so, we must be careful not to explain *growth in genuine wealth per capita* with variables, such as the value of resource rents, government expenditure on education etc., that are themselves part of the empirical definition of genuine investment. For the purpose of the statistical analysis, we have divided the sample of up to 110 countries into three cross-sections, covering the years 1996-1999, 2000-2003, and 2004-2007, respectively. The dependent variable is *growth in genuine wealth per capita* and our baseline specification is the following panel model:[31]

(11) $$dlngw_{it} = \beta_0 CORRUPTION_{it} + \sum_{k=1}^{\bar{k}} \beta_{1k} INSTITUTIONS_{it}^{k} + \sum_{l=1}^{\bar{l}} \beta_{1l} STOCKS_{it}^{l} + \sum_{s=1}^{\bar{s}} \beta_{1l} SHADOW_{it}^{l} + \mu_i + \gamma_t + \varepsilon_{it} ,$$

where *i* is a country index and *t=1,2,3* represent the three cross-sections. The error term has three sub-components: μ_i represents unobserved country-specific determinants of sustainability that do not vary over time; γ_t represents common time-specific shocks to sustainability, and ε_{it} represents all unobserved determinants of sustainability that vary over time within a country. The variable CORRUPTION corresponds to one of the six corruption indices discussed above, while the variables INSTITUTIONS, STOCKS and SHADOW represent the three major categories of control variables suggested by theory, namely the proxies for political and legal institutions, for the capital stocks, and for the accounting or shadow prices (as discussed below).

Only one of the six corruption indices (the *ICRG index*) has potentially meaningful over-time variation. So, for the bulk of the estimations, the variation used to estimate β_0 comes from the cross-section only. The theory refers to institutions, broadly defined. Corruption is clearly part of

[31] We prefer to use *growth in genuine wealth per capita* directly rather than a dichotomous classification into sustainable (positive growth) and unsustainable economies (negative growth), along the lines of Table 2. This is because sustainability is measured with a great deal of error and such a classification would inevitably allocate countries to the wrong category.

this, but the underlying political and legal institutions clearly play a pivotal role. Conceptually, these may be of influence in their own right, i.e., irrespective of the level of corruption. One possibility is that the variations in political accountability systematically affect the time horizon of politicians and thus their incentive to invest in the economy's capital assets (Aidt and Dutta, 2007). Another is that some legal environments make it hard to enforce inter-temporal contracts. However, it is also clear that that political and legal institutions are amongst the key determinants of corruption (Paldam, 2002; Treisman, 2000) and that they may affect the extent to which corruption adversely affects economic outcomes.[32] As a matter of fact, in our sample, the correlation between the various corruption indices and the other governance indicators in the World Bank's Governance Matters Database[33] is higher than -0.75, with the exception of the index of the rule of law (-0.15). In the baseline specifications, we include one proxy for the legal framework and one for the quality of political institutions. Our choice of proxy is guided by the desire to avoid too much multicollinearity. We use a dummy variable as a proxy for legal institutions (*common law*), to show whether the legal code of the country falls under common law or not (La Porta et al., 1997). The correlation between this variable and corruption is relatively low (less than -0.15). The variable is meant to capture systematic differences in the contracting environment, rather than variations in the rule of law as such. We use two alternative measures as a proxy for the quality of political institutions. The first is the Freedom House Index of Political Freedom (*political freedom*).[34] Freedom House rates countries according to the degree of political pluralism and participation, and the functioning of the government, based on the judgment of a panel of experts. We have adjusted the index such that higher values on the scale from 1 to 7 reflect institutions that function better. Since one of the categories used to construct this index refers to whether the government is free from pervasive corruption, it is directly related to corruption, yet its correlation with the corruption indices is lower than for the governance indictors from the Governance Matters Database. Moreover, the index has variation over time, which we shall explore in the estimations. The other indicator of the quality of political institutions is a measure of their experience with democracy (*democracy*), suggested by

[32] See, e.g., Aidt et al. (2008) or Bhattacharyya and Hodler (2010).
[33] See Kaufmann et al., (2005, 2006) or www.govindicators.org. The indicators are the index of Voice and Accountability, the index of Political Stability and Absence of Violence/Terrorism; the index of Government Effectiveness, and the index of Regulatory Quality.

[34] http://www.freedomhouse.org

Treisman (2007). We record whether or not a country is a democracy as of the year in question (1996, 2000 or 2004) based on the classification of Beck et al. (2001). If it was a democracy at the relevant junction[35], the variable *democracy* then records the number of consecutive years since 1930 that the political system was democratic. In other words, we attempt to measure how consolidated a democracy is in each country. If the country is not democratic at the relevant junction, *democracy* takes on the value of 0. The variable *democracy* includes time, as well as cross-national variation, and its correlation with the corruption indices is relatively high (around -0.67). It is important to stress that, by conditioning on these proxies for institutional quality, our estimate of the impact of corruption on sustainability (β_0 in equation (11)) captures the effect of corruption over and above that which can be explained by the checks on corruption induced by the institutional framework. In other words, if β_0 is estimated to be zero, it does not necessarily mean that corruption is irrelevant for sustainability; it may still exercise an influence through dysfunctional institutions. We shall return to this point in Section 6.4.

It is difficult to control for stocks of the various capital assets. The best we can do is to employ three imperfect proxies. One is the average years of schooling for the population aged 15 and over, lagged by 5 five years (*human capital*).[36] This is only available for 69 of the 110 countries in the sample, but is the best available proxy for cross-national differences in the stock of human capital. The other proxy is PPP adjusted real GDP per capita (from the World Economic Indicators) suitably lagged (*GDP per capita*). This proxies for the stock of manufactured and human capital, but also picks up the flow of natural resources used in the production process, and so is, by construction, correlated with genuine investment. It is, therefore, a questionable proxy, a fact that should be kept in mind when interpreting the results.[37] The third proxy is for social capital. Bjørnskov (2007), among others, reports a strong negative correlation between survey measures of social capital and income inequality. This suggests that we can use the Gini coefficient[38] to proxy for social capital (*inequality*). A higher Gini coefficient corresponds to larger income inequality, and thus to a smaller stock of social capital. We have considered various proxies for the stock of natural capital, such as fuel export relative to total manufacturing

[35] Democracies are those with a score of 6 or higher on Beck et al.'s (2001) measure of executive constraints.
[36] The source for this is Barro and Lee (2001).
[37] The main results are not affected if we exclude *GDP per capita* from the estimations.
[38] The source for this is UNDP (2004).

exports, or the World Bank's (2006) estimate of the stock of natural capital. The two main problems with these measures are that they relate directly to the extraction of natural resources (fuel exports), rather than to the stock, and that they are constructed from the same data on resources rents that are used to estimate genuine investment. For this reason, we do not include any of these measures in the baseline specifications, but consider them as part of the robustness analysis in Section 7.

It is even more difficult to find proxies for the relevant accounting or shadow prices. The best we can do here is to note that world market prices can, in some cases, serve as shadow prices. The extent to which this is relevant depends on a country's involvement in international trade. This can, in turn, be measured by the variable *trade openness* which records spending on imports of goods and services as a percentage of GDP (and is sourced from World Economic Indicators). It is clear, however, that this is more related to whether local prices are linked to world market prices than to any specific values of the relevant shadow prices, and thus not a very accurate proxy. Appendix Table A1 reports summary statistics for all the variables used in the statistical analysis.

6. Estimation results

The major statistical challenge is to obtain a robust and unbiased estimate of β_0, the effect of corruption on *growth in genuine wealth per capita*. We rise to that challenge by estimating equation (11) in three different ways. First, we use a pooled ordinary least squares (OLS) estimator with panel-corrected standard errors; second, we use the Hausman-Taylor random effects estimator; and, third, we use an instrumental variables (IV) estimator. We discuss the merits of these techniques and the results they yield in the following sub-sections.

6.1 Pooled OLS estimates

Our first estimation approach pools the three cross-sections and estimates the model with ordinary least squares (OLS). We allow for panel heteroskedasticity and for spatial correlations between the error terms across countries, and the reported standard errors of the parameter estimates are panel-corrected standard errors (PCSEs), as recommended by Beck and Katz (1995).

[Table 3: *Growth in Genuine Wealth per capita* and Perceived Corruption, 1996-2007: Specification with *Democracy*.]

[Table 4: *Growth in Genuine Wealth per capita* and Perceived Corruption, 1996-2007: Specification with *Political Freedom*.]

[Table 5: *Growth in Genuine Wealth per capita* and Experienced Corruption, 1996-2007: Specification with *Democracy*.]

[Table 6: *Growth in Genuine Wealth per capita* and Experienced Corruption, 1996-2007: Specification with *Political Freedom*.]

The results are presented in four tables. Tables 3 and 4 show estimations based on the three indices of perceived corruption, but differ with regard to how we control for political institutions (the specifications in Table 3 control for *democracy* while those in Table 4 control for *political freedom*). Tables 5 and 6 show a similar set of estimations, but these are based on the three indices of experienced corruption. All specifications control for *common law* and include a full set of regional dummy variables, and time-fixed effects [not reported in the Tables]. Moreover, for each combination of corruption index and institutional control variable, we show two specifications; one with the four control variables – *inequality*, *gdp per capita*, *human capital*, and *trade openness* – and one without. The main reasons for reporting both specifications are, firstly, that 30 observations are lost when we add the four additional control variables[39] and, secondly, that one can question the appropriateness of these control variables.

Taken together, the estimations reported in the four tables demonstrate that, conditional on the quality and type of political and legal institutions, corruption, however it is measured, is significantly negatively correlated with *growth in genuine wealth per capita*. This correlation is

[39] The bottleneck is *human capital*.

robust across many different specifications, with and without the extra control variables. The negative effect is particularly pronounced in the specifications based on individuals' self-reported experience with corruption (Tables 5 and 6). It is somewhat less robust in the specifications with perceived corruption. In particular, corruption is insignificant in the specifications based on the *ICRG index* (see columns (5) and (6) of Tables 3 and 4).[40] This suggests that petty corruption is at least as important as grand corruption.

To get a sense of the magnitude of the effect, we may consider the point estimate for the *TI index* reported in column (1) of Table 3 (-0.30). Take a country, Denmark, with one of the lowest average *TI index* scores over the period (0.40) and imagine that corruption in Denmark suddenly increased to the level perceived to prevail in a country with one of the highest average *TI index* scores, Nigeria (8.5). Then *growth in genuine wealth per capita* would fall from a healthy 2.37 percent to -0.06. In other words, the sharp increase in corruption would make the development path of Denmark unsustainable! Alternatively, let us consider the point estimate on the *GCB index* reported in column (3) of Table 6 (-0.034). In the OECD economies covered by the survey, less than one percent of the respondents claim that they were asked for a bribe during the past year. In the country with the highest score (Cameroon), 52 percent of respondents reported that they had paid a bribe. So, a country that went from the "OECD level" of one percent to the "African level" of 50 percent would, *ceteris paribus*, see its growth rate of genuine wealth per capita reduced by 1.73 percentage points. Of course, these examples are extreme in that they consider unrealistically big jumps in corruption. Yet, they serve the purpose of illustrating that the effect of corruption on *growth in genuine wealth per capita* is of economic, as well as statistical, significance.

While corruption is robustly related to sustainability, it is harder to detect a consistent pattern with respect to political and legal institutions. The two measures of political institutions, *democracy* and *political freedom*, are mostly insignificant, but occasionally, we find a positive and significant effect, suggesting that established democratic institutions and political freedom

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[40] It is not the fact that we explore the variation over time in the ICRG index that is behind this. Similar results emerge if we time-average the index [not reported here].

may contribute to sustainable development (over and above the effect they may have on corruption). Our measure of legal institutions, *common law*, is significant in about half the specifications. The point estimate is negative. This suggests that countries with a common law system perform worse than countries with a civil law (or some other legal) system. Common law systems tend to promote financial development because they offer better protection of investors (La Porta et al. 1998). Combined with our finding, this suggests that financial development and sustainable development may not go hand in hand.

The economic control variables matter in some, but far from all, specifications. First, *gdp per capita* has a negative effect on sustainability, as one would expect if it proxies for the stocks of manufactured and human capital. Second, *inequality* has a negative effect, as one would expect if equality is associated with more social capital and trust. Third, *human capital* and *trade openness* both have positive effects on *growth in genuine wealth per capita*. The latter effect is what one would expect if international trade brings domestic market prices closer to their accounting prices; the former effect is more puzzling and suggests that the number of years of schooling relates to something other than the stock of human capital (perhaps, social capital).[41]

6.2. Hausman-Taylor estimates

For a variety of reasons, the estimates presented in Tables 3 to 6 are unlikely to represent a causal effect. One major issue is that the six corruption indices are correlated with unobserved country-specific factors, such as culture, history and, insofar as they are not controlled for by related to our proxies for political and legal institutions, institutional factors. In other words, it is possible that $Cov(CORRUPTION_i, \mu_i) \neq 0$. In principle, we could address this issue with a fixed effects estimator. The problem, however, is that five of the six corruption indices have little meaningful variation over time, and the variation that does occur over time in one– the *ICRG index* –is not strong enough to accommodate a fixed effects estimator. The standard random effects estimator is not appropriate either because corruption, as measured by the six indices, is almost surely correlated with the unobserved country-specific factors. The only way forward,

[41] The most immediate explanation for this result, however, is that there is persistence in school expenditures, so that the expenditures in the past are correlated with expenditures in the present and, therefore, with current education attainment levels.

then, is to employ the Hausman-Taylor estimator.[42] This estimator is designed to address the problem that corruption is endogenous in the sense of being correlated with unobserved country-specific factors, and has the advantage that we do not have to find external instruments. More specifically, the estimator is based on the assumption that while the relevant corruption index and the relevant measure of political institutions may be correlated with unobserved country-specific effects, none of other independent variables are so correlated. In addition, we must assume that all the independent variables are uncorrelated with the time-varying country-specific error term (ε_{it}). Given these assumptions, we can use the time-averaged values of the exogenous time-varying variables as instruments for (a random effects transformation of) the corruption index and the deviation from the time-average of the endogenous time-varying variable as an instrument for (a random effects transformation of) the measure of political institutions (Wooldridge, 2002). We can test the appropriateness of these instruments using a Hausman over-identification test. This test evaluates the Hausman-Taylor model against its fixed effects counterpart (where the effects of all the time-invariant variables are subsumed in the fixed effect). If the test statistic is insignificant, then the Hausman-Taylor estimator is consistent *and* more efficient than its fixed effects counterpart.

[Table 7: *Growth in Genuine Wealth per capita* and Corruption, 1996-2007: The Hausman-Taylor Estimator specification with *Democracy*.]

[Table 8: *Growth in Genuine Wealth per capita* and Corruption, 1996-2007: The Hausman-Taylor Estimator specification with *Political Freedom*.]

The estimation results are reported in Tables 7 and 8. We exclude *human capital* from all the specifications shown in order to maximize sample size, but note that so doing makes little difference to the results. The Hausman over-identification test reported at the bottom of the Tables 7 and 8 supports, in each case, the choice of the Hausman-Taylor model. The picture remains clear with regard to the effect of corruption on *growth in genuine wealth per capita*: irrespective of the corruption index used, and irrespective of how we control for political institutions, corruption has a significant negative effect on sustainability. The magnitude of the

[42] See Hauseman and Taylor (1981).

effect is larger than that reported previously[43], suggesting that once we take unobserved country-specific factors such as culture, geography, history, etc. into account, the effect of corruption is even more substantial than when we do not do so. On the other hand, it is clear from Tables 7 and 8 that the *direct* effect of political institutions is largely eliminated by the fixed effects, while *common law* occasionally has a significant negative effect on sustainability.

6.3. Instrumental variables estimates

The Hausman-Taylor estimator deals with one type of endogeneity, namely that related to unobserved country-specific determinants of sustainability, but not with others. In particular, the approach assumes that the corruption indices (and the other explanatory variables) are uncorrelated with all unobserved country-specific *time-varying* determinants of sustainability. This would not be the case if growth in genuine wealth affects corruption (reverse causality), if corruption is measured with error, or if our control variables do not pick up all aspects of the institutional and economic environment that might affect both corruption and sustainability (omitted variables).

These are real issues, and to address them, we need to find external instruments for corruption, i.e., we need to find variables that are correlated with corruption, but uncorrelated with all unobserved determinants of growth in genuine wealth. In other words, we need to find variables that affect sustainability only through their effect on corruption. This is a tall order. The best we can do is to follow the literature and pick instrumental variables that have proved useful in previous research on the economic consequence of corruption. Mauro (1995), La Porta et al. (1998), Hall and Jones (1999), and Gupta et al. (2002), amongst others, have suggested that ethno-linguistic fractionalization (*ethnicity*)[44], past corruption levels (the *initial ICRG index*), and distance from the equator (*latitude*) can all be used as instruments for corruption in GDP growth or income inequality regressions. It is not difficult to find objections to these instruments. While

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[43] Strictly speaking, we cannot directly compare these estimates to those reported in Tables 3 to 6 since these specifications include *human capital*. However, whether or not this variable is included makes little difference to the size of the point estimates [not reported], so no large error is introduced by making the comparison.

[44] See Taylor and Hudson (1972).

the presence of many different ethnic groups may foster corruption because public officials favor their own group at the expense of others, or because this leads to less coordinated bribe-taking, it is quite possible that the degree of fractionalization is directly related to sustainable development. For example, Easterly and Levine (1997) show that ethno-linguistic fractionalization is related to economic growth and, as we discuss in more detail below, ethno-linguistic fractionalization is, in fact, strongly correlated with *growth in genuine wealth per capita*. Lagged values are relevant instruments, but are only valid if there is no series correlation left in the error term of the outcome regression. Although Hall and Jones (1999) proposed a measure of distance from equator as an instrument for social infrastructure – a composite index that includes, as one component, corruption – it is really an instrument for institutions, defined broadly, rather than for a specific aspect of governance, such as corruption. Moreover, Acemoglu (2005) questions the underlying rationale for focusing on the distance from equator, namely that "good" institutions spread from Europe to geographically similar regions.

With these significant caveats in mind, Table 9 reports some instrumental variables estimations based on these three instruments. We have time-averaged the dependent variable *growth in genuine wealth per capita* and effectively treat the data as one cross section. We only report specifications where we use *democracy* to control for political institutions and where we do not include any of the economic control variables.[45] Statistically speaking, the three instruments work reasonably well for the *TI* and *WB index*. They are jointly significant in the first stage of the two stage estimation procedure and the p-value on the Hansen J test for over-identification is large. For the *ICRG index* and the *WBES index*, however, the instruments fail the standard specification tests. Focusing, then, on the estimations for the *TI index* and the *WB index*, we see that the point estimates are somewhat larger in absolute value than the corresponding OLS estimates, reported at the bottom of the table, and are also statistically significant. This suggests that the OLS estimates might be biased towards zero. Such a bias is consistent both with measurement error and reverse causality.

[Table 9: Instrumental Variables Estimates (2SLS); Endogenous variable: Corruption.]

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[45] The results when *political freedom* is used instead of *democracy* are very similar. The IV estimates of β_0 are not significant when the full set of economic control variables are included.

6.4. Hierarchies of institutions

Our estimation strategy so far has been predicated on the assumption that political and legal institutions affect sustainability directly and that the effect of corruption can be estimated conditionally on the institutional context. However, it may be more instructive to think in terms of a hierarchy of institutions. At the top of the hierarchy, we find political and legal institutions. These determine the equilibrium level of corruption. This, then, determines economic outcomes (here, sustainability). Another way to state the same point is to note that "corruption is a *symptom* that something has gone wrong in the management of the state. Institutions designed to govern the interrelationships between the citizens and the state are used instead for personal enrichment and the provision of benefits to the corrupt." (Rose-Ackerman, 1999, page 9, italics added). Persson (2004) and Eicher and Leukert (2009) also advocate this line of reasoning as a guide to empirical research. Within our present context, the logic of a hierarchy of institutions implies that we should use our measures of political and legal institutions as instruments for corruption. That is, we should, first, estimate the impact of institutions on corruption, and, then, estimate the impact of corruption on sustainability.

Table 10 presents the results from a two-stage least squares (2SLS) estimation procedure based on this logic, in which we use *democracy* and *common law* as additional instruments for corruption (we also continue to use the three instruments introduced above). The estimates obtained in this way are highly statistically significant and suggest that corruption has a large negative effect on *growth in genuine wealth per capita*. Equally importantly, the new instruments perform well statistically: they can explain corruption in the first stage (i.e. they are 'relevant' instruments) and they have no difficulty passing the Hansen J test. Of course, this test can only tell us whether the new instruments are valid (i.e., uncorrelated with the unobserved component of sustainability) *conditional* on at least one of the other instruments being valid (which may not be the case). Yet, the results are encouraging for the "hierarchies of institutions" hypothesis. In particular, these results leave the door open for the interpretation that institutions may mainly exercise an influence on sustainable development because they control the extent of corruption.

[Table 10: Instrumental Variables Estimates (2SLS); The "Hierarchies of Institutions" Hypothesis.]

7. Robustness analysis

We have undertaken a larger number of robustness checks. First, visional inspection of the data makes it clear that outliers could be an issue. In particular, Angola and Democratic Republic of Congo stand out from the rest in that they experienced extremely high negative growth in genuine wealth during the late 1990s and early 2000s. We have re-estimated the various statistical models without those two countries and there is little difference to the results. We have also re-estimated the models presented in Tables 3 to 6 using an outlier robust estimator (the least-absolute-value estimator). This makes a difference in some specifications but, for the vast majority of specifications, we conclude that the correlations reported above are not driven by outliers. Second, we have included a number of additional control variables. Firstly, sustainable development might be hindered by war and civil conflict. To control for this, we include a measure of the number of armed conflicts (external and internal) in which the government of each country was involved during the period 1995-2000 (*conflict*).[46] We also use the ethno-linguistic fractionalization index as a proxy for internal conflict (*ethnicity*). The variable *conflict* is mostly insignificant, and adding it to the various statistical models does not affect the conclusions regarding corruption. On the other hand, the variable *ethnicity* has a negative and significant effect on *growth in genuine wealth per capita* across the board, but, again, adding it to the statistical model does not affect the conclusions regarding corruption. This, however, casts doubt on the validity of *ethnicity* as an instrument for corruption. As a consequence, we re-estimated the instrumental variables' regressions shown in Tables 9 and 10 without *ethnicity*. The results are very similar to those reported in the two tables. Third, in the main specifications, we did not control for the stock of natural capital. We could provide proxies for this by two different means, as discussed in Section 5: either by including a measure of the export value of mineral fuels as a percentage of manufacturing exports (sourced from the World Development

[46] These data can be obtained from the Quality of Government Institute, Goteborg University at http://www.qog.pol.gu.se/.

Indicators), or by the World Bank's (2006) proxy for resource wealth. Both of these are, as noted, problematic because they are directly related to the calculation of genuine investment, however, we have tried to include them in the statistical model. As expected, both of these variables correlate negatively with *growth in genuine wealth per capita*, but adding them to the model does not affect the conclusions related to corruption.[47]

8. Conclusion

The analysis presented in this Chapter suggests that corruption is one of the major obstacles to sustainable development. We consistently find that cross-national measures of corruption perceptions, as well as measures of direct experience with corruption are negatively correlated with *growth in genuine wealth per capita* and that this correlation is robust and to controlling for the quality and type of institutions, the stock of human capital, openness to trade, initial GDP per capita, inequality and many other observable determinants of sustainability. It is also robust to controlling for unobserved country-specific effects. Finally, our instrumental variables' estimates all point in the same direction, and suggest that a causal effect may be at play and that political and legal institutions exercise their influence on sustainability through corruption. However, even if the thorny issue of causality has not been fully settled – and we acknowledge that it is unlikely to be resolved – the robustness of the correlation is itself remarkable, not least when our results are contrasted with those that emerge from empirical studies of the effect of corruption on economic growth.

The data on genuine investment used in the analysis are, as pointed out above, problematic in many regards and there is great scope for improvement. For example, instead of using public expenditure on education to approximate investment in human capital, it would be better to use information on the social return to education from country-specific surveys. Combined with data on educational attainment from, say, the Barro-Lee dataset (Barro and Lee, 2001), one could obtain a much better estimate for the social value of investment in the stock of human capital. It

[47] Norman (2009) provides an estimate of the reserves of fuel and 35 non-fuel commodities in US$ per capita in 1970. This must be considered as an exogenous determinant of growth in genuine wealth during the period 1996 to 2007, and so could be use to control for initial resource stocks in future work.

would also be desirable to collect country-specific information on total factor productivity growth and use that to adjust the data on growth in genuine wealth. Better estimates on the environmental cost of carbon emission could also be obtained. Finally, the World Bank's estimate of genuine investment does not make any attempt to take distributional effects into account, either between different individuals at given point of time, or between different generations of individuals. It is an established fact that the incidence of corruption falls disproportionately on the poor (see Gupta et al., 2002): they rely more on public services (e.g., schools and health facilities) than the rich and thus suffer more from the reduction in the quantity and quality of provision caused by corruption. This could be captured by introducing distributional weights in the calculation of genuine investment. All of these adjustments can, in principle, be made but are very labor intensive. However, they should be placed high on the future research agenda.

It is difficult draw concrete policy conclusions from a macro-level study of the kind conduced here. Such specific advice must come from micro-level evidence on the effects of particular policy measures. Nevertheless, one can point to general insights of policy relevance that emerge from the analysis. Most obviously, the message that the paper tries to send to policy makers thinking about what to do about corruption is that the issue is not so much what corruption does (or does not do) to the economic growth of a country; the real issue is that rampant corruption endangers sustainable development. As a consequence, reform effects, both in terms of concrete anti-corruption policies and in terms of governance reforms, should be directed at weeding out corrupt practices that reduce the incentive to protect and preserve the capital base. This includes control of corruption in relation to exploration of natural assets with high social value and in the enforcement of environmental regulation. It also includes policies aimed at preventing corruption and rent-seeking in the allocation of public funds for education, as well as policies that weed out, or reduce, the "corruption tax" on domestic and international investment flows.

9. References

Acemoglu, Daron. 2005. "Constitutions, Politics and Economics: A Review Essay on Persson and Tabellini's 'The Economic Effects of Constitutions'," Journal of Economic Literature 43(4): 1025-1048.

Acemoglu, Daron, and Thierry Verdier. 1998. "Property Rights, Corruption and the Allocation of Talent: A General Equilibrium Approach," Economic Journal 108: 1381-1403.

Acemoglu, Daron, Simon Johnson, and James A. Robinson. 2001. "The Colonial Origins of Development: An Empirical Investigation," American Economic Review 91(5): 1369-1401.

Aidt, Toke S. 2003. "Economic Analysis of Corruption: A Survey," Economic Journal 113: F632-F652.

Aidt, Toke S, and Jayasi Dutta. 2007. "Policy Myopia and Economic Growth," European Journal of Political Economy 23: 734-753.

Aidt, Toke S, Jayasri Dutta, and Vania Sena. 2008. "Governance Regimes, Corruption and Growth: Theory and Evidence," Journal of Comparative Economics 36: 195-220.

Aidt, Toke S. 2009. "Corruption, Institutions and Economic Development," Oxford Review of Economic Policy 25: 271-291.

Alt, James, and David Dreyer Lassen. 2003. "The Political Economy of Institutions and Corruption in American States," Journal of Theoretical Politics 15(3): 341-65.

Arrow, Kenneth J., Partha Dasgupta, Lawrence Goulder, Gretchen Daily, Paul Ehrlich, Geoffrey Heal, Simon Levin, Karl-Göran Mäler, Stephen Schneider, David Starrett, and Brian Walker. 2004. "Are We Consuming Too Much?," The Journal of Economic Perspectives 18(3): 147-172.

Arrow, Kenneth J., Partha Dasgupta, and Karl-Göran Mäler. 2003. "The Genuine Savings Criterion and the Value of Population," Economic Theory 21(2): 217-225.

Atkinson, Giles, and Kirk Hamilton. 2003. "Saving, Growth and the Resource Curse Hypothesis," World Development 31: 1793-1807.

Auty, Richard M. 1993. Sustaining Development in Mineral Economies. (London: Routledge)

Bardhan, Pranab. 1997. "Corruption and Development: A Review of Issues," Journal of Economic Literature XXXV: 1320-1346.

Barro, Robert J., and Jong-Wha Lee. 2001. "International Data on Educational Attainment: Updates and Implications," Oxford Economic Papers 53: 541-563.

Bhattacharyya, Sambit, and Roland Hodler. 2010. "Natural Resources, Democracy and Corruption," European Economic Review 54: 608-621.

Beck, Nathaniel, and Jonathan N. Katz. 1995. "What to Do (and Not to Do) With Time-series Cross-section data," American Political Science Review 89(3): 634-647.

Beck, Torsten, George Clarke, Alberto Groff, Philip Keefer, and Patrick Walsh. 2001. "New Tools in Comparative Political Economy: The Database of Political Institutions," World Bank Economic Review 15(1): 165-176.

Bjørnskov, Christian. 2007. "Determinants of Generalized Trust: A Cross-country Comparison," Public Choice 130: 1-21.

Blackburn, Keith, Niloy Bose, and Emranul M. Haque. 2006. "The Incidence and Persistence of Corruption in Economic Development," Journal of Economic Dynamics and Control 30: 2447-2467.

Blackburn, Keith, Niloy Bose, Emranul M. Haque. 2008. "Endogenous Corruption in Economic Development," Unpublished Working Paper, Department of Economics, University of Wisconsin.

Bolt, Katharine, Mampite Matete, and Michael Clemens. 2002. "Manual for Calculating Adjusted Net Savings," Unpublished Working Paper Environmental Department, the World Bank, Washington DC.

Brunnschweiler, Christa N, and Erwin H. Bulte. 2008. "The Resource Curse Revisited and Revised: A Tale of Paradoxes and Red Herrings," Journal of Environmental Economics and Management 55(3): 248-264.

Campos, J. Edgardo, Donald Lien, and Sanjay Pradhan. 1999. "The Impact of Corruption on Investment: Predictability Matters," World Development 27(6): 1059-67.

Dasgupta, Partha. 2001. Human Well-being and the Natural Environment (Oxford: Oxford University Press).

Dasgupta, Partha, "The Place of Nature in Economic Development," in Dani Rodrik and Mark Rosenzweig, eds., 2010. Handbook of Development Economics, Vol. 5 (Amsterdam: North Holland).

Dasgupta, Partha, and Karl-Göran Mäler. 2000. "Net National Product, Wealth, and Social Well-being," Environment and Development Economics 5(1): 69-93.

Del Monte, Alfredo, and Erasmo Papagni. 2001. “Public Expenditure, Corruption and Economic Growth: The Case of Italy,” European Journal of Political Economy 17: 1-16.

Easterly, William R, and Ross E. Levine. 1997. “Africa's Growth Tragedy: Policies and Ethnic Divisions,” Quarterly Journal of Economics 111: 1203-50.

Egger, Peter, and Hannes Winner. 2005. “Evidence on Corruption as an Incentive for Foreign Direct Investment,” European Journal of Political Economy 21: 932-52.

Ehrlich, Isaac, and Francis T. Lui. 1999. “Bureaucratic Corruption and Endogenous Growth,” Journal of Political Economy 107(6): S270-S293.

Eicher, Theo S and Andreas Leukert. 2009. “Institutions and Economic Performance: Endogeneity and Parameter Heterogeneity,” Journal of Money, Credit and Banking 41(1): 197-219.

Ellis, Chis J, and John Fender. 2006. “Corruption and Transparency in a Growth model,” International Tax and Public Finance 13(2-3): 115-149.

Fleurbaey, Marc. 2009. “Beyond GDP: The Quest for a Measure of Social Welfare,” Journal of Economic Literature 474: 1029-1075.

Frey, Bruno S, and Alois Stutzer. 2002. Happiness and Economics. How the Economy and Institutions Affect Human Well-being (Princeton New Jersey: Princeton University Press)

Golden, Mariam, and Lucio Picci. 2005. “Proposal for a New Measure of Corruption, Illustrated with Italian Data,” Economics and Politics 17: 37-75.

Guerriero, Carmine. 2010. “Democracy, Judicial Attitudes and Heterogeneity: The Civil Versus Common Law Tradition,” Amsterdam Center for Law and Economics (ACLE) Working Papers, 2010-10, University of Amsterdam, The Netherlands.

Gundlach, Erich, and Martin Paldam. 2009a. “The Transition of Corruption: From Poverty to Honesty,” Economics Letters 103(3): 146-148.

Gundlach, Erich, and Martin Paldam. 2009b. “A Farewell to Critical Junctures: Sorting out Long-run Causality of Income and Democracy,” European Journal of Political Economy 25: 340-354.

Gupta, Sanjeev, Hamid R. Davoodi, and Rosa Alonso-Terme. 2002. “Does Corruption Affect Income Inequality and Poverty?,” Economics of Governance 3(1): 23-45.

Gylfason, Thorvaldur. 2001. “Natural Resources, Education and Economic Development,” European Economic Review 45: 847-859.

Hall, Robert E., and Charles I. Jones. 1999. "Why Do Some Countries Produce So Much More Output Per Worker Than Others?," Quarterly Journal of Economics 114(1): 83-116.

Hamilton, Kirk, and Clemens, Michael. 1999. "Genuine Savings Rates in Developing Countries," World Bank Economic Review 13(2): 333-356.

Hamilton, Kirk. 2005. "Sustaining Economic Welfare: Estimating Changes in Per Capita Wealth," World Bank Policy Research Working Paper No. 2498, The World Bank, Washington D.C.

Hausman, Jerry A., and William E. Taylor. 1981. "Panel Data and Unobserved Individual Effects," Econometrica 49: 1377-1398.

Hodler, Roland. 2006. "The Curse of Natural Resources in Fractionalized Countries," European Economic Review 50: 1367-1386.

Jain Arvind K. 2001. "Corruption: A Review," Journal of Economic Surveys 15 (1): 71-121.

Kaufmann, Daniel, and Aart Kraay. 2002. Growth Without Governance (Washington DC: the World Bank)

Kaufmann, Daniel, Aart Kraay, and Massimo Mastruzzi. 2005. "Governance Matters IV: Governance Indicators for 1996-2004," Working paper. The World Bank, Washington, DC.

Kaufmann, Daniel, Aart Kraay, and Massimo Mastruzzi, "Measuring Governance Using Cross-country Perceptions Data," in Susan Rose-Ackerman , ed., 2006. International Handbook on the Economics of Corruption (Cheltenham UK: Edward Elgar)

Krusell, Per, and José-Víctor Rios-Rull. 1996. "Vested Interests in a Positive Theory of Stagnation and Growth," Review of Economic Studies 63: 301-329.

La Porta, Rafael, Florencio Lopez de-Silanes, Andrei Shleifer, and Robert W. Vishny. 1997. "Legal Determinants of External Finance," Journal of Finance 52(3), Papers and Proceedings: 1131-1150.

La Porta, Rafael, Florencio Lopez de-Silanes, Andrei Shleifer, and Robert W. Vishny.1998. "Law and Finance," Journal of Political Economy 106(6): 1113-55.

Lane, Philip R., and Aaron Tornell. 1996. "Power, Growth, and the Voracity Effect," Journal of Economic Growth 1(2): 213-41.

Lambsdorff, Johann G. 2005. Consequences and Causes of Corruption: What do we Know From a Cross section of Countries (Passau: University of Passau).

Lambsdorff, Johann G. 2007. The Institutional Economics of Corruption and Reform (Cambridge UK: Cambridge University Press)

Leff, Nathan. 1964. "Economic Development Through Bureaucratic Corruption," American Behavioral Scientist 8(3): 8-14.

Leite, Carlos, and Jens Weidmann, "Does Mother Nature Corrupt? Natural Resources, Corruption, and Economic Growth," in George T. Abed and Sanjeev Gupta, eds., 2002. Governance, Corruption and Economic Performance (Washington DC: the International Monetary Fund)

Levy, Daniel. 2007. "Price Adjustment Under the Table: Evidence on Efficiency-enhancing Corruption," European Journal of Political Economy 23: 423-447.

Mauro, Paolo. 1995. "Corruption and Growth," Quarterly Journal of Economics 110: 681-712.

Mauro, Paolo. 1998. "Corruption and Composition of Government Expenditure," Journal of Public Economics 69: 263-279.

Mehlum, Halvor, Karl Moene, and Ragnar Torvik. 2006. "Institutions and the Resource Curse," Economic Journal 116(508): 1-20.

Méndez, Fabio, and Facundo Sepúlveda. 2006. "Corruption, Growth and Political Regimes: Cross-country Evidence," European Journal of Political Economy 22 (1): 82-98.

Méon, Pierre-Guillaume and Laurent Weill. 2010. "Is Corruption an Efficient Grease?," World Development 38(3): 244-259.

Mo, Pak H. 2001. "Corruption and Economic Growth," Journal of Comparative Economics 29: 66-79.

Murphy, Kevin M., Andrei Shleifer, and Robert W. Vishny. 1991. "The Allocation of Talent: Implications for Growth," Quarterly Journal of Economics 106: 503-30.

Murphy, Kevin M., Andrei Shleifer, and Robert W. Vishny.1993. "Why is Rent Seeking so Costly to Growth?," American Economic Review, Paper and Proceedings 83: 409-414.

Neumayer, Eric. 2004. "Does the 'Resource Curse' Hold for Growth in Genuine Income as Well?," World Development 32(10): 1627-40.

Norman, Catherine S. 2009. "Rule of Law and the Resource Curse: Abundance Versus Intensity," Environmental and Resource Economics 43(2): 183-207.

Paldam, Martin. 2002. "The Cross-country Pattern of Corruption: Economics, Culture and the Seesaw Dynamics," European Journal of Political Economy 18(2): 215-240.

Papurakis, Elissaios and Reyer Gerlagh. 2006. "Resource Windfalls, Investment, and Long-term Income," Resource Policy 31: 117-28.

Persson, Torsten. 2004. "Presidential Address: Consequences of Constitutions," Journal of the European Economic Association 2(2-3): 139-161.

Ploeg, Frederick van der, and Steven Poelhekke. 2009. "Volatility and the Resource Curse," Oxford Economic Papers 61(4): 727-760.

Ploeg, Frederick van der, and Steven Poelhekke. 2010. "The Pungent Smell of 'Red Herrings': Subsoil Assets, Rents, Volatility and the Resource Curse," Journal of Environmental Economics and Management 60: 44-55.

Reinikka, Ritva, and Jakob Svensson. 2004. "Local Capture: Evidence from a Central Government Transfer Program in Uganda," Quarterly Journal of Economics 119(2): 679-706.

Robinson, James A., Ragnar Torvik, and Thierry Verdier. 2006. "Political Foundations of the Resource Curse," Journal of Development Economics 79: 447-68.

Rodriguez, Francisco, and Jeffrey D. Sachs. 1999. "Why do Resource Abundant Economies Grow More Slowly? A New Explanation and Application to Venezuela," Journal of Economic Growth 4: 277-303.

Rose-Ackerman, Susan. 1999. Corruption and Government, Causes, Consequences and Reform (Cambridge UK: Cambridge University Press)

Sachs, Jeffery D., and Andrew M. Warner, "Natural Resource Abundance and Economic Growth," in Gerald M. Meier and James Rauch, eds., 1997. Leading Issues in Economic Development (Oxford UK: Oxford University Press)

Sena, Vania, and Natalia Martianova. 2008. "Corruption and Foreign Direct Investment in Russian Regions," Unpublished Working Paper, Aston Business School, UK.

Shleifer, Andrei, and Robert W. Vishny. 1993. "Corruption," Quarterly Journal of Economics 108: 599-618.

Svensson, Jakob. 2005. "Eight Questions About Corruption," Journal of Economic Perspectives 19(3): 19-42.

Tanzi, Vito. 1998. "Corruption Around the World: Causes, Consequences, Scope, and Cures," IMF Staff Papers 45(4): 559-594.

Tanzi, Vito, and Hamid R. Davoodi. 1998. “Corruption, Public Investment and Growth,” in Hirofumi Shibata and Toshiro Ihori, eds., 1998. The Welfare State, Public Investment and Growth (Tokyo: Springer-Verlag)

Taylor, Charles L., and Michael C. Hudson. 1972. World Handbook of Political and Social Indicators (Ann Arbor MI: ICSPR).

Treisman, Daniel. 2000. “The Causes of Corruption: A Cross-national Study,” Journal of Public Economics 76: 399-457.

Treisman, Daniel. 2007. “What Have we Learned About the Causes of Corruption From Ten Years of Cross-national Empirical Research?,” Annual Review of Political Science 10: 211-244.

United Nations Development Program (UNDP). 2004. Human Development Report (New York: United Nations)

Wei, Shang-Jin. 2000. “How Taxing is Corruption on International Investors?,” Review of Economics and Statistics 82(1): 1-11.

Wooldridge, Jeffery M. 2002. Econometric Analysis of Cross Section and Panel Data (Cambridge MA: The MIT Press).

World Bank, 2006. Where is the Wealth of Nations? Measuring Capital for the 21st Century (Washington DC: The World Bank)

World Bank, various years. World Development Indicators (Washington DC: the World Bank)

World Commission, 1997. Our common future (New York: Oxford University Press)

Appendix

Table A1: Summary statistics for the variables used in the regression analysis

Variable	Years	Obs.	Mean	Std. Dev.	Min.	Max.
Growth in Genuine wealth per capita	1996-1999	148	-0.16	2.56	-12.46	5.01
ICRG Index	1996-1999	140	2.80	1.21	0.00	5.35
Democracy	1996-1999	132	17.56	22.20	0.00	65.00
Political Freedom	1996-1999	133	3.51	2.19	0.00	6.00
GDP per capita	1996-1999	128	0.80	0.81	0.00	3.45
Human capital	1996-1999	100	6.17	2.78	0.76	11.89
Trade Openness	1996-1999	125	39.68	22.22	1.96	147.65
Growth in Genuine wealth per capita	2000-2003	146	-0.22	2.60	-13.57	5.49
ICRG Index	2000-2003	140	3.31	1.13	0.00	5.69
Democracy	2000-2003	132	21.37	23.22	0.00	70.00
Political Freedom	2000-2003	133	3.60	2.13	0.00	6.00
GDP per capita	2000-2003	129	0.93	0.97	0.00	4.87
Human capital	2000-2003	100	6.43	2.80	0.84	12.05
Trade Openness	2000-2003	123	42.84	23.13	9.37	139.12
Growth in Genuine wealth per capita	2004-2007	143	-0.14	2.83	-19.00	5.51
ICRG Index	2004-2007	140	3.50	1.15	0.00	6.00
Democracy	2004-2007	132	25.24	24.30	0.00	75.00
Political Freedom	2004-2007	133	3.61	2.14	0.00	6.00
GDP per capita	2004-2007	128	1.05	1.11	0.00	6.12
Human capital	2004-2007	100	6.43	2.80	0.84	12.05
Trade Openness	2004-2007	123	42.84	23.13	9.37	139.12
TI index	1996-2007	128	5.72	2.26	0.40	8.55
WB index	1996-2007	135	0.64	0.28	0.00	1.06
WBES index	1996-2007	70	1.87	0.88	0.16	4.22
GCB index	1996-2007	59	12.08	11.72	0.00	52.00
UNICRI index	1996-2007	44	8.76	8.99	0.04	31.11
Common Law	1996-2007	130	0.31	0.46	0.00	1.00
Inequality	1996-2007	106	40.12	9.78	24.00	63.00
Latitude	1996-2007	133	27.56	17.59	0.00	64.80
Ethnicity	1996-2007	114	0.45	0.28	0.00	0.91

Notes: The definitions of the variables are provided in the main text.

Table 1: Genuine Investment in Selected Countries, average figures 1996-2007

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
	Gross saving	Consump-tion of fixed capital	Educa-tion expendi-ture	Damage from $C0_2$ emission	Particu-late emission damage	Energy deple-tion	Mineral deple-tion	Forest depletion	Genuine investment	Growth rate of per capita genuine wealth	Growth rate of per capita GDP (1970-2000)
	% of GNI	% of GNI	% of GNI	% of GNI	% of GNI	% of GNI	% of GNI	% of GNI	% of GNI	%	%
India	28.43	9.33	3.93	1.41	0.68	3.10	0.50	0.78	16.56	0.88	2.79
Brazil	15.48	11.37	4.30	0.31	0.28	2.19	1.24	0.00	4.39	-0.74	2.07
Thailand	31.24	13.64	4.62	1.04	0.30	3.09	0.01	0.26	17.50	1.53	4.68
Nigeria	27.85	8.85	0.85	0.66	0.78	45.57	0.00	0.06	-27.22	-6.78	0.79
Kenya	14.08	9.54	5.82	0.41	0.18	0.00	0.05	1.35	8.37	-1.24	1.44
USA	15.00	11.84	4.79	0.34	0.25	0.85	0.04	0.00	6.46	0.49	1.76
UK	15.13	10.58	5.33	0.20	0.05	1.66	0.00	0.00	7.97	1.39	1.98

Notes: Damage from CO_2 emissions is based on a marginal cost of $30 per tonne.
Sources: World Development Indicators (various years), Hamilton (2005), Aidt et al. (2008).

Table 2a: Cross-tabulation of *growth in genuine wealth per capita* and the *WB index*

	Low corruption			**High corruption**		
Sustainable	Mongolia Tunisia Latvia Morocco Switzerland Cyprus Hong Kong New Zealand Netherlands Bulgaria Thailand Italy United Kingdom United States Greece	France Sweden Belgium Denmark Spain Bahamas Croatia Canada Uruguay Turkey Botswana Sri Lanka Slovenia Estonia Iceland	Japan Norway Ireland Singapore Malaysia Czech Rep. Portugal Luxembourg Austria Finland Germany Poland Korea, Rep. Hungary	Indonesia Philippines Vietnam Mexico India Belarus Armenia El Salvador Romania Dominican Republic	Jamaica Honduras Bangladesh Ukraine Moldova Algeria China	Lithuania Panama Guyana Russia Albania
Unsustainable	Costa Rica Egypt Brunei Darussalam Israel Peru	Jordan Australia Brazil Chile	Saudi Arabia Madagascar Trinidad and Tobago South Africa Burkina Faso	Mozambique Syrian Tanzania Nicaragua Argentina Venezuela Congo, Dem. Rep. Sudan Ecuador Togo Zimbabwe Azerbaijan Guatemala	Malawi Iran Lebanon Gambia, The Niger Paraguay Guinea-Bissau Gabon Colombia Senegal Ethiopia Congo, Rep. Cameroon	Mali Haiti Guinea Angola Ghana Uganda Sierra Leone Bolivia Kenya Pakistan Zambia

Notes: Sustainable (unsustainable) means that *growth in genuine wealth per capita* is positive (negative). High (low) corruption means a score on the *WB index* above (below) the median. Source: World Development Indicators (various years) and Kaufmann et al. (2005).

Table 2b: Cross-tabulation of *growth in genuine wealth per capita* and the *WBES index*

	Low corruption	**High corruption**
Sustainable	Poland Germany Lithuania Portugal Bulgaria Estonia Tunisia Slovenia Italy Singapore Canada Uruguay UK Spain Malaysia Panama USA Botswana Honduras Czech Republic Sweden Belarus Croatia El Salvador Hungary Russia	Turkey Moldova Ukraine Thailand Albania Mexico France Philippines India Indonesia Bangladesh Armenia Dominican Republic Romania
Unsustainable	Trinidad and Tobago Colombia South Africa Guatemala Costa Rica Brazil Chile	Madagascar Uganda Cameroon Egypt. Pakistan Nicaragua Peru Argentina Ghana Ethiopia Ecuador Bolivia Zambia Senegal Zimbabwe Azerbaijan Haiti Venezuela

Notes: Sustainable (unsustainable) means that *growth in genuine wealth per capita* is positive (negative). High (low) corruption means a score on the *WBES index* above (below) the median.
Source: World Development Indicators (various years) and
http://info.worldbank.org/governance/wbes/

Table 3: *Growth in Genuine Wealth per Capita* and Perceived Corruption, 1996-2007: Specification with *Democracy*

Estimation technique: Pooled OLS with Panel-Corrected Standard Errors

Dep. Variable: *Growth in Genuine Wealth per Capita*

	(1)	(2)	(3)	(4)	(5)	(6)
TI Index	-0.30***	-0.20**				
	[-4.42]	[-2.16]				
WB Index			-2.90***	-2.10**		
			[-4.70]	[-2.45]		
ICRG Index					-0.032	0.13
					[-0.31]	[1.29]
Democracy	0.0073	0.0036	0.0066	0.0022	0.029***	0.0075
	[1.37]	[0.73]	[1.11]	[0.43]	[4.61]	[1.52]
Common Law	0.070	-0.49**	0.025	-0.42*	0.059	-0.42*
	[0.29]	[-1.97]	[0.11]	[-1.70]	[0.24]	[-1.68]
Inequality		0.012		0.013		0.0097
		[0.64]		[0.67]		[0.48]
GDP per capita		-0.46**		-0.61***		-0.17
		[-2.12]		[-2.58]		[-0.87]
Human Capital		0.18***		0.20***		0.27***
		[2.66]		[3.13]		[3.93]
Trade Openness		0.010***		0.0095***		0.011***
		[3.38]		[3.09]		[3.56]
Observations	310	230	322	233	322	233
R-squared	0.54	0.57	0.56	0.58	0.52	0.57
Number of countries	106	78	110	79	110	79

Notes: All estimations include a full set of regional dummies, time-specific fixed effects and a constant term. Robust z-statistics are given in brackets. *** p<0.01, ** p<0.05, * p<0.1

Table 4: *Growth in Genuine Wealth per Capita* and Perceived Corruption, 1996-2007: Specification with *Political Freedom*						
Estimation technique: Pooled OLS with Panel-Corrected Standard Errors						
Dep. Variable: *Growth in Genuine Wealth per Capita*						
	(1)	(2)	(3)	(4)	(5)	(6)
TI Index	-0.30***	-0.22**				
	[-4.28]	[-2.46]				
WB Index			-2.83***	-2.43***		
			[-4.69]	[-2.87]		
ICRG Index					-0.080	0.11
					[-0.74]	[1.11]
Political Freedom	0.11*	-0.040	0.089	-0.080	0.27***	0.0072
	[1.66]	[-0.50]	[1.31]	[-1.01]	[3.46]	[0.087]
Common Law	0.11	-0.45*	0.065	-0.39	0.25	-0.37
	[0.45]	[-1.88]	[0.28]	[-1.63]	[1.04]	[-1.49]
Inequality		0.012		0.013		0.011
		[0.64]		[0.65]		[0.52]
GDP per capita		-0.40*		-0.58**		-0.084
		[-1.81]		[-2.38]		[-0.40]
Human Capital		0.18***		0.21***		0.28***
		[2.77]		[3.27]		[4.10]
Trade Openness		0.010***		0.0097***		0.011***
		[3.29]		[3.01]		[3.46]
Observations	310	230	322	233	322	233
R-squared	0.54	0.57	0.56	0.58	0.52	0.57
Number of countries	106	78	110	79	110	79

Notes: All estimations include a full set of regional dummies, time-specific fixed effects and a constant term. Robust z-statistics are given in brackets. *** p<0.01, ** p<0.05, * p<0.1

Table 5: *Growth in Genuine Wealth per Capita* and Experienced Corruption, 1996-2007: Specification with *Democracy*

Estimation technique: Pooled OLS with Panel-Corrected Standard Errors

Dep. Variable: *Growth in Genuine Wealth per Capita*

	(1)	(2)	(3)	(4)	(5)	(6)
WBES index	-0.90***	-0.44**				
	[-5.30]	[-2.31]				
GCB Index			-0.022**	-0.031***		
			[-2.24]	[-3.33]		
UNICRI Index					-0.061***	-0.035*
					[-2.93]	[-1.95]
Democracy	0.020***	0.015**	0.022***	0.017***	0.015**	0.018
	[3.35]	[2.45]	[4.45]	[3.65]	[2.14]	[1.59]
Common Law	-0.52**	-0.63**	-0.29	-0.90***	-1.28***	-1.47***
	[-2.06]	[-2.42]	[-1.18]	[-4.61]	[-3.05]	[-2.95]
Inequality		0.028		-0.029***		0.040
		[1.47]		[-3.13]		[1.41]
GDP per capita		0.19		-0.063		-0.17
		[0.80]		[-0.36]		[-0.57]
Human Capital		0.12*		0.053		0.17**
		[1.84]		[1.03]		[1.98]
Trade Openness		0.0061		0.0084***		0.0030
		[1.14]		[2.68]		[0.47]
Observations	192	154	159	128	125	101
R-squared	0.58	0.58	0.69	0.79	0.54	0.57
Number of countries	65	52	55	44	42	34

Notes: All estimations include a full set of regional dummies, time-specific fixed effects and a constant term. Robust z-statistics are presented in brackets. *** p<0.01, ** p<0.05, * p<0.1

Table 6: *Growth in Genuine Wealth per Capita* and Experienced Corruption, 1996-2007: Specification with *Political Freedom*

Estimation technique: Pooled OLS with Panel-Corrected Standard Errors

Dep. Variable: *Growth in Genuine Wealth per Capita*

	(1)	(2)	(3)	(4)	(5)	(6)
WBES index	-0.96***	-0.41**				
	[-5.47]	[-2.21]				
GCB Index			-0.034***	-0.035***		
			[-2.66]	[-3.37]		
UNICRI Index					-0.075***	-0.037**
					[-3.99]	[-2.21]
Political Freedom	0.16***	0.21**	0.036	0.013	0.042	0.15
	[2.70]	[2.42]	[0.50]	[0.21]	[0.72]	[1.06]
Common Law	-0.36	-0.52**	-0.073	-0.76***	-0.85**	-1.06**
	[-1.47]	[-2.06]	[-0.29]	[-3.26]	[-2.02]	[-2.14]
Inequality		0.035*		-0.022**		0.035
		[1.84]		[-2.36]		[1.20]
GDP per capita		0.26		0.14		-0.038
		[0.99]		[0.73]		[-0.12]
Human Capital		0.11		0.075		0.20**
		[1.48]		[1.31]		[2.22]
Trade Openness		0.0041		0.0083**		0.0045
		[0.84]		[2.29]		[0.72]
Observations	192	154	159	128	125	101
R-squared	0.57	0.58	0.66	0.76	0.52	0.56
Number of countries	65	52	55	44	42	34

Notes: All estimations include a full set of regional dummies, time-specific fixed effects and a constant term. Robust z-statistics are presented in brackets. *** p<0.01, ** p<0.05, * p<0.1

Table 7: *Growth in Genuine Wealth per Capita* and Corruption, 1996-2007: The Hausman-Taylor Estimator with *Democracy*

Estimation technique: Hausman-Taylor Random Effects Estimator, treating Corruption and *Democracy* as endogenous

Dep. Variable: *Growth in Genuine Wealth per Capita*

	(1)	(2)	(3)	(4)	(5)	(6)
TI Index	-1.04***					
	[-3.36]					
WB Index		-10.4***				
		[-4.08]				
ICRG Index			-0.17*			
			[-1.72]			
WBES Index				-2.98***		
				[-4.13]		
GCB Index					-0.28***	
					[-3.07]	
UNICRI Index						-0.21***
						[-2.83]
Democracy	-0.011	-0.032	0.055***	0.010	-0.026	-0.0079
	[-0.38]	[-1.12]	[3.49]	[0.36]	[-0.74]	[-0.25]
Common Law	-0.84*	-0.44	-1.01*	0.67	-0.75	-1.00
	[-1.96]	[-0.94]	[-1.78]	[0.92]	[-0.97]	[-1.43]
Inequality	-0.046**	-0.034	-0.08***	-0.11***	-0.077**	-0.042*
	[-2.12]	[-1.48]	[-3.21]	[-3.78]	[-2.12]	[-1.66]
GDP per capita	-1.24***	-1.23***	-0.99***	-1.68***	-1.26***	-0.80*
	[-4.01]	[-3.84]	[-3.42]	[-3.58]	[-4.25]	[-1.89]
Trade Openness	0.0054	0.0060	0.0039	-0.0058	0.012	-0.018
	[0.88]	[0.94]	[0.58]	[-0.68]	[1.35]	[-1.54]
Observations	279	285	285	187	150	125
Number of countries	95	97	97	63	52	42

Notes: All estimations include time-specific fixed effects and a constant term. Z-statistics are presented in brackets. *** p<0.01, ** p<0.05, * p<0.1

Table 8: *Growth in Genuine Wealth per Capita* and Corruption, 1996-2007: The Hausman-Taylor Estimator with *Political Freedom*

Estimation technique: Hausman-Taylor Random Effects Estimator, treating Corruption and *Political Freedom* as endogenous

Dep. Variable: *Growth in Genuine Wealth per Capita*

	(1)	(2)	(3)	(4)	(5)	(6)
TI Index	-0.93***					
	[-5.36]					
WB Index		-7.94***				
		[-5.53]				
ICRG Index			-0.17*			
			[-1.74]			
WBES Index				-3.20***		
				[-4.95]		
GCB Index					-0.24***	
					[-5.33]	
UNICRI Index						-0.20***
						[-3.91]
Political Freedom	0.02	0.01	0.11	-0.05	-0.14	-0.005
	[0.21]	[0.12]	[1.43]	[-0.60]	[-1.59]	[-0.042]
Common Law	-0.91**	-0.70*	-0.43	0.82	-1.04*	-1.08*
	[-2.35]	[-1.83]	[-0.87]	[1.23]	[-1.67]	[-1.94]
Inequality	-0.050**	-0.045**	-0.083***	-0.11***	-0.087***	-0.044**
	[-2.56]	[-2.33]	[-3.39]	[-3.65]	[-2.89]	[-2.06]
GDP per capita	-1.26***	-1.31***	-0.27	-1.60***	-1.34***	-0.87***
	[-4.21]	[-4.28]	[-1.28]	[-3.81]	[-4.77]	[-2.73]
Trade Openness	0.0057	0.0077	0.0012	-0.0069	0.015*	-0.016*
	[0.96]	[1.27]	[0.18]	[-0.85]	[1.73]	[-1.66]
Observations	279	285	285	187	150	125
Number of countries	95	97	97	63	52	42

Notes: All estimations include time-specific time effects and a constant term. Z-statistics are presented in brackets. *** p<0.01, ** p<0.05, * p<0.1

Table 9: Instrumental Variables Estimates (2SLS)								
Endogenous variable: Corruption								
Instruments: *Latitude*, *Initial ICRG Index*, and *ethnicity*								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Stage	2nd	1st	2nd	1st	2nd	1st	2nd	1st
Dep. Variable	Growth in genuine wealth	TI index	Growth in genuine wealth	WB index	Growth in genuine wealth	ICRG index	Growth in genuine wealth	WBES index
TI index, instrumented	-0.47**							
	[-2.57]							
WB Index, instrumented			-3.93***					
			[-2.83]					
ICRG index, instrumented					-0.44			
					[-1.18]			
WBES index, instrumented							-2.72**	
							[-2.10]	
Democracy	-0.0021	-0.04***	-0.0016	-0.01***	0.016	-0.02***	-0.028	-0.011**
	[-0.13]	[-4.50]	[-0.10]	[-5.33]	[0.95]	[-4.58]	[-1.16]	[-2.03]
Common law	0.099	-0.78**	0.30	-0.067**	0.38	0.045	0.075	-0.33
	[0.20]	[-2.63]	[0.75]	[-2.01]	[0.96]	[0.24]	[0.072]	[-1.12]
Latitude		-0.035*		-0.0044*		-0.0067		-0.0017
		[-1.76]		[-1.97]		[-0.93]		[-0.17]
Initial ICRG index		0.49**		0.055**		0.37***		0.11
		[2.18]		[2.40]		[3.94]		[0.72]
Ethnicity		0.54		0.060		-0.35		0.75
		[0.66]		[0.61]		[-0.79]		[1.05]
OLS estimate	-0.36***		-3.40***		-0.13		-0.67*	
	[-3.20]		[-3.80]		[-0.60]		[-1.84]	
First stage F-statistics		12.11		14.79		12.1		2.19
Over-ID test (p-value)	0.33		0.12		0.03		0.63	
Observations	86	86	96	96	96	96	51	51
R-squared	0.43	0.75	0.51	0.76	0.44	0.65	0.36	0.41

Notes: Robust z-statistics are presented in brackets; *** p<0.01, ** p<0.05, * p<0.1; all estimations contain regional dummy variables.

Table 10: Instrumental Variables Estimates (2SLS): The "Hierarchies of Institutions" Hypothesis								
Endogenous variables: Corruption								
Instruments: *Democracy*, *Common Law*, *Latitude*, *Initial ICRG Index* and *ethnicity*								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Stage	2nd	1st	2nd	1st	2nd	1st	2nd	1st
Dep. Variable	Growth in genuine wealth	TI index	Growth in genuine wealth	WB index	Growth in genuine wealth	ICRG index	Growth in genuine wealth	WBES index
TI index, instrumented	-0.45***							
	[-5.25]							
WB Index, instrumented			-3.93***					
			[-5.75]					
ICRG index, instrumented					-0.84***			
					[-4.90]			
WBES index, instrumented							-1.60***	
							[-3.29]	
Democracy		-0.037***		-0.0048***		-0.020***		-0.011**
		[-4.50]		[-5.33]		[-4.58]		[-2.03]
Common law		-0.78**		-0.067**		0.045		-0.33
		[-2.63]		[-2.01]		[0.24]		[-1.12]
Latitude		-0.035*		-0.0044*		-0.0067		-0.0017
		[-1.76]		[-1.97]		[-0.93]		[-0.17]
Initial ICRG index		0.49**		0.055**		0.37***		0.11
		[2.18]		[2.40]		[3.94]		[0.72]
Ethnicity		0.54		0.060		-0.35		0.75
		[0.66]		[0.61]		[-0.79]		[1.05]
First stage F-statistics		46.32		58.77		21.47		5.21
Over-ID test	0.66		0.35		0.15		0.43	
Observations	86	86	96	96	96	96	51	51
R-squared	0.43	0.75	0.50	0.76	0.38	0.65	0.19	0.41

Notes: Robust z-statistics are presented in brackets; *** p<0.01, ** p<0.05, * p<0.1; all estimations contain regional dummy variable.